

Name: \_\_\_\_\_

TA: \_\_\_\_\_

## Question 2 (30 points)

### a) ~~Transcription~~

i. ~~is the process that transfers information from \_\_\_\_\_ to \_\_\_\_\_.~~

ii. ~~in eukaryotic organisms, transcription occurs in the~~

~~Nucleus~~

~~Ribosome~~

~~Membrane~~

### b) ~~Translation~~

i. ~~is the process that transfers information from \_\_\_\_\_ to \_\_\_\_\_.~~

ii. ~~in eukaryotic organisms, translation occurs in the~~

~~Nucleus~~

~~Ribosome~~

~~Membrane~~

~~The following sequence of DNA encodes a hypothetical polypeptide called Playdo in a hypothetical bacteria *E. hypotheticalus*. Transcription starts at and includes the C/G base pair in bold. The underlined T/A base pair indicates the terminator.~~

~~5' - TT**CC**CCTATGGATGGTCATCTACGATGCCCCATCACTAAAGCTTG - 3'  
3' - AAGGGGATACCTACCAGTAGATGCTACGGGGGTAGTGATTTTCGAAC - 5'~~

e) ~~What are the first 6 bases of the transcribed RNA? Be sure to label the 5' and 3' ends.~~

d) ~~What are the first 3 amino acids of the subsequent polypeptide? Be sure to label the N- and C-termini.~~

e) ~~How many total amino acids are encoded in this polypeptide?~~

You identify a strain of bacteria containing a mutant tRNA that is capable of adding a tryptophan residue when it recognizes the codon UAG in the mRNA.

f) What is the sequence of the anticodon of the mutant tRNA? Be sure to label the 5' and 3' ends.

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## Question 2, continued

longer

g) The Playdo polypeptide would be the same length in the presence of the mutant tRNA.

shorter

Why?

You isolate a mutant bacteria with the Playdo gene sequence below. The bold, boxed G/C base pair is the site of the only difference between wild-type and mutant Playdo – a substitution of a G/C base pair for a A/T base pair. As before, the bold C/G base pair indicates the start of transcription, and the underlined T/A base pair indicates the terminator.

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5' - TTCCCCTATGGGTGGTCATCTACGATGCCCCATCACTAAAGCTTG - 3'
3' - AAGGGGATACCCACCAGTAGATGCTACGGGGGTAGTGATTTCGAAC - 5'
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h) What is the effect of this substitution on the peptide?

i) Do you expect this peptide to have the same function as the wild-type bacterial peptide? Why or why not?

~~Intrigued by Playdo, you search for a similar protein in mice by looking for similar DNA sequences in the mouse genome. You find a gene that matches bacterial Playdo almost perfectly but contains a 36 DNA base pair insertion in the center of it.~~

~~When you purify the Playdo polypeptide from mouse cells you are shocked to learn that mouse Playdo is the same length in amino acids as bacterial Playdo.~~

~~j) Explain how is it possible that mouse Playdo and bacterial Playdo are the same polypeptide length even though they have substantially different gene lengths.~~

~~k) Do you expect bacterial and mouse Playdo to have the same promoter and terminator sequences? Why or why not?~~

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## Question 2 (30 points)

### a) ~~Transcription~~

i. ~~is the process that transfers information from DNA to RNA.~~

ii. ~~in eukaryotic organisms, transcription occurs in the~~

~~Nucleus                      Ribosome                      Membrane~~

### b) ~~Translation~~

i. ~~is the process that transfers information from RNA to protein.~~

ii. ~~in eukaryotic organisms, translation occurs in the~~

~~Nucleus                      Ribosome                      Membrane~~

~~The following sequence of DNA encodes a hypothetical polypeptide called Playdo in a hypothetical bacteria *E. hypotheticus*. Transcription starts at and includes the C/G base pair in bold. The underlined T/A base pair indicates the terminator.~~

~~5' - TT**CC**CCTATGGATGGTCATCTACGATGCCCCATCACTAAAGCTT**G** - 3'  
3' - AAGGGGATACCTACCAGTAGATGCTACGGGGGTAGTGATTT**CGA**AC - 5'~~

c) ~~What are the first 6 bases of the transcribed RNA? Be sure to label the 5' and 3' ends.~~

~~5' - CCCUA - 3'~~

d) ~~What are the first 3 amino acids of the subsequent polypeptide? Be sure to label the N- and C-termini.~~

~~N-Met-Asp-Gly-C~~

e) ~~How many total amino acids are encoded in this polypeptide?~~

~~The gene encodes 10 amino acids. The 11<sup>th</sup> in-frame codon is the stop codon UAA.~~

You identify a strain of bacteria containing a mutant tRNA that is capable of adding a tryptophan residue when it recognizes the codon UAG in the mRNA.

f) What is the sequence of the anticodon of the mutant tRNA? Be sure to label the 5' and 3' ends.

3'-AUC-5' or 5'-CUA-3'

**Question 2, continued**longerg) The Playdo polypeptide would be the same length in the presence of the mutant tRNA.shorter

Why?

*The length of Playdo would be the same in the presense of the mutant tRNA because the Playdo gene sequence does not include the TAG, so the mutant tRNA would never be used in translating Playdo*

You isolate a mutant bacteria with the Playdo gene sequence below. The bold, boxed G/C base pair is the site of the only difference between wild-type and mutant Playdo—a substitution of a G/C base pair for a A/T base pair. As before, the bold C/G base pair indicates the start of transcription, and the underlined T/A base pair indicates the terminator.

5' - TT**CC**CCCTATGG**G**TGGTCATCTACGATGCCCCCATCACTAAAGCTT**G** - 3'  
 3' - AA**G**GGGATACC**C**ACCAGTAGATGCTACGGGGGTAGTGATTT**CGA**AC - 5'

h) What is the effect of this substitution on the peptide?

*The second amino acid in the peptide, Asp, is changed to Gly in this mutant variant.*

i) Do you expect this peptide to have the same function as the wild-type bacterial peptide?

Why or why not?

*We would not expect the mutant Playdo to function like the wild-type peptide. This is because the mutant peptide now has Gly in place of Asp. Asp is a charged amino acid, while Gly is not charged. In addition, Asp is significantly larger than Gly, which has the smallest side chain of all the amino acids. This substitution is likely to affect tertiary structure of Playdo, and, therefore, to alter its function.*  
~~Intrigued by Playdo, you search for a similar protein in mice by looking for similar DNA sequences in the mouse genome. You find a gene that matches bacterial Playdo almost perfectly but contains a 36 DNA base pair insertion in the center of it.~~

~~When you purify the Playdo polypeptide from mouse cells you are shocked to learn that mouse Playdo is the same length in amino acids as bacterial Playdo.~~

~~j) Explain how is it possible that mouse Playdo and bacterial Playdo are the same polypeptide length even though they have substantially different gene lengths. Mouse genes have introns—regions of DNA within the coding sequence of a gene that do not get translated. These regions are spliced out of the initial transcript when mRNA is prepared. The 36 extra base pairs in the mouse gene are such an intron.~~

~~k) Do you expect bacterial and mouse Playdo to have the same promoter and terminator sequences? Why or why not?~~

~~The promoter and terminator sequences belong to a language written in DNA that is “read” by the transcription machinery. This language is not universal, but is species-specific. Therefore, we would not expect bacteria and mouse to have the same promoter and terminator sequences.~~